



## Case Report

# Tracheoplasty using a suprahyoid release for adenoid cystic carcinoma: Report of an oncologic emergency case

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## ABSTRACT

Anastomosis of the tracheal ends requires sufficient mobilization of the trachea because excessive tension is the principal cause of anastomotic insufficiency. Several mobilization and release techniques can be used to reduce some of the anastomotic tension of the trachea. Of these, Montgomery's suprahyoid release technique is a surgical method that severs three muscles above the hyoid bone: the mylohyoid, geniohyoid, and genioglossus. Of these, we present the suprahyoid release technique here because we believe that it is superior to the other mobilization techniques, particularly supralaryngeal release. This is the first report to approach this subject from both anatomical and functional perspectives. In summary, we performed a tracheoplasty requiring a suprahyoid release for a 55-year-old female with adenoid cystic carcinoma as an oncologic emergency. We should master the supralaryngeal release, particularly wide resection of the trachea, because this technique provides sufficient mobilization, with no dysphagia or complications.

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## 1. Introduction

Anastomosis of the tracheal ends requires sufficient mobilization of the trachea because excessive tension is the principal cause of anastomotic insufficiency.<sup>1,2</sup> Several mobilization and release techniques can be used to reduce some of the anastomotic tension of the trachea<sup>3</sup>: neck flexion; digital dissection of the trachea along the anterior, pretracheal plane; the suprahyoid<sup>4</sup> and supralaryngeal<sup>5</sup> release procedures; and the intrapericardial hilar release with elevation of the carina. Of these, we present the suprahyoid release technique here because we believe that it is superior to the other mobilization techniques, particularly supralaryngeal release. This is the first report to approach this subject from both anatomical and functional perspectives. We do not think anyone doing a substantial amount of tracheal surgery would consider doing anything other than a suprahyoid release if an upper tracheal release is required. However, the major point of this paper is not that the suprahyoid release is essential, but that general thoracic surgeons should learn it.

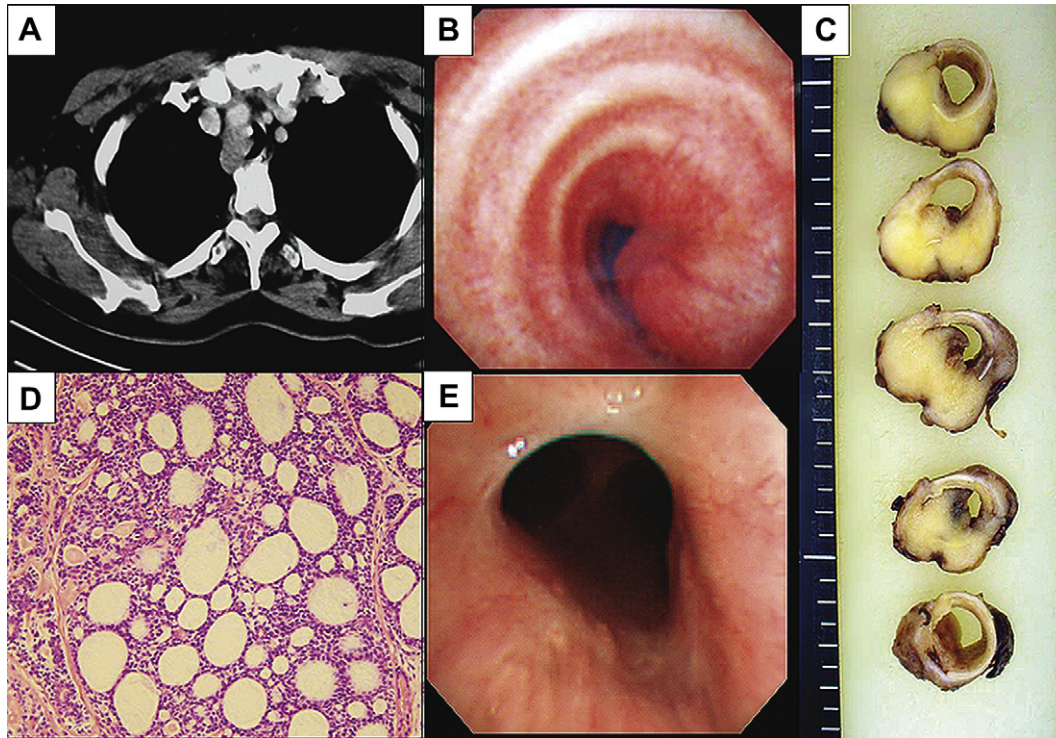
## 2. Case

A 55-year-old woman was sent to a nearby hospital because she complained of sudden dyspnea and lost consciousness. Chest X-ray and computed tomography revealed a tracheal mass protruding into the tracheal lumen that narrowed the trachea, located mainly in the middle third of the trachea (Fig. 1A). Consequently, the patient was transferred to our emergency room by ambulance. On arrival, she was drowsy and dyspneic, and could barely breathe in the sitting position. To avoid suffocation, she was intubated immediately with an endotracheal tube having a 6-mm inner diameter using a flexible bronchofiberscope. Endoscopy demonstrated that the nodular mass obstructed the trachea nearly completely (Fig. 1B). We placed the tip of the tracheal tube just before the carina. She had no relevant medical history. After intubation, her blood pressure was 131/68 and pulse was 75/min. The PaO<sub>2</sub> was 100 mmHg and the PaCO<sub>2</sub> 34 mmHg. The other hematological and biochemical parameters were within normal limits. We scheduled a radical operation for 3 days later.

## 3. Operation

*Preparation for surgery:* the patient was placed in the supine position and her neck was extended with a pillow under her back.

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**Fig. 1.** A, Computed tomography shows a tracheal mass protruding into and narrowing the tracheal lumen, located mainly in the middle third of the trachea. B, Endoscopy showed a nodular mass obstructing the trachea nearly completely. C, The resected specimen shows a mass measuring 3.5 cm in maximum diameter invading the tracheal wall near-circumferentially and protruding into the tracheal lumen. D, Histologically, small, stellate, dark or occasionally light tumor cells are arranged in nests or sheets fenestrated by round or oval spaces—the cribriform subtype of adenoid cystic carcinoma (H&E,  $\times 100$ ). E, Postoperative endoscopy shows no stenosis at the anastomosis, and no symptoms or tumor recurrence are observed 4 years after surgery.

We confirmed that the endotracheal tube had passed into the lower trachea through the stenotic area. General anesthesia was administered.

**Approach:** a median sternotomy with a collar incision was made because the lesion was located mainly in the second-third of the trachea. We dissected the innominate vein and artery, and exposed the entire trachea. The dissection of the trachea was limited to within the surrounding fascia for mobilization, while the posterior tracheal wall was left intact.

**Surgical field:** the mass measured 3.5 cm in maximum diameter and was located mainly in the second-third of the trachea. We resected the proximal and distal sides of the trachea one ring from the margin of the mass. Subsequently, cross-field intubation was performed. A frozen section of the mass yielded a diagnosis of adenoid cystic carcinoma. Since the tracheal stumps were cancer-positive, we performed additional resections of the proximal and distal sides of the trachea, ultimately resecting eight rings of the trachea. The remaining trachea was too short to achieve mobilization of the trachea to decrease the tension on the anastomosis, so we planned to perform the suprahyoid release technique.<sup>4</sup>

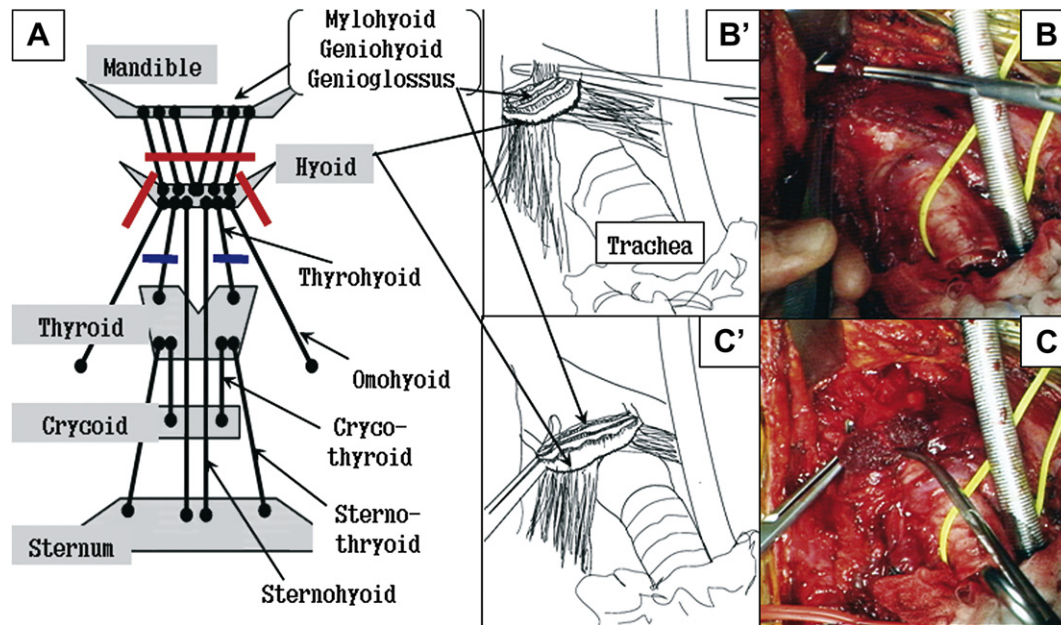
**Suprahyoid release:** the mylohyoid, geniohyoid, and genioglossus muscles were separated from the superior surface of the hyoid bone. Subsequently, the greater and lesser horns were severed from the body of the hyoid bone bilaterally. Then, the hyoid bone body was freed and moved inferiorly (Fig. 2).

**Anastomosis:** we started suturing from the posterior wall first between the distal and proximal trachea, and completed the anastomosis using 3-0 absorbable monofilaments with 16 interrupted sutures through all layers of the cartilage ring. After completing half of the sutures, we switched the cross-field intubation to the

standard procedure. No air leaked at the anastomosis in a sealing test performed under 30 cmH<sub>2</sub>O pressure. The anastomosis was covered with thymic fatty tissue. Finally, 28-Fr and 24-Fr chest tubes were placed in the right thorax and anterior mediastinum, respectively. At the end of the operation, a stout suture (1-0 silk) was secured between the skin of the chin and chest to keep the neck flexed. The operating time was 310 min and the blood loss was 400 g.

**Pathological finding:** the resected specimen showed a mass measuring 3.5 cm in maximum diameter invading the tracheal wall near-circumferentially and protruding into the tracheal lumen (Fig. 1C). Histologically, we observed small, stellate, dark or occasionally light tumor cells arranged in nests or sheets fenestrated by round or oval spaces—the cribriform subtype of adenoid cystic carcinoma (Fig. 1D). The tumor invaded the tracheal cartilage and submucosa, and showed submucosal extension. As a result, part of the distal tracheal stump was cancer-positive.

**Postoperative course:** postoperatively, the patient was transferred to the intensive care unit with an endotracheal tube. The chest tubes were removed on postoperative day (POD) 2. The stout suture in the neck was removed on POD 7. She developed pneumonia, but recovered gradually, and the endotracheal tube was removed on POD 22. Diet for swallowing training began on POD 23. She moved to a general ward on POD 24, and started to eat an ordinary diet on POD 28. The patient underwent radiotherapy (total dose of 60 Gray) for the residual tumor cells in the tracheal stump. She was discharged on POD 100. Postoperative endoscopy performed 4 years after the surgery showed no stenosis at the anastomosis and no symptoms or tumor recurrence (Fig. 1E). She was doing well without recurrence 56 months postoperatively and is being followed as an outpatient.



**Fig. 2.** A, Three muscles attach to the superior surface of the hyoid bone: the mylohyoid, geniohyoid, and genioglossus muscles. These muscles are separated from the hyoid bone. B, Subsequently, the greater and lesser horns are separated from the body of the hyoid bone bilaterally. C, Then, the hyoid bone body is freed and moved inferiorly. B and C, Diagram of the surgical procedure corresponding to Fig. 2B and C, respectively.

#### 4. Discussion

First, we describe two mobilization techniques for the trachea<sup>3</sup>: Montgomery's suprahyoid release technique<sup>4</sup> and the laryngeal release technique of Dedo and Fishman<sup>5</sup>.

Montgomery's<sup>4</sup> suprahyoid release technique is a surgical method that severs three muscles above the hyoid bone: the mylohyoid, geniohyoid, and genioglossus. It permits the trachea to move from 2 to 3 cm.<sup>6</sup> The three suprahyoid muscles constitute the substance of the mouth floor, supporting the hyoid in providing a base from which the tongue functions, and elevating the hyoid and larynx during swallowing and tone production.<sup>6</sup> The mylohyoid elevates the hyoid, floor of the mouth, and tongue during swallowing and speaking.<sup>6</sup> The geniohyoid pulls the hyoid anterosuperiorly, shortens the floor of the mouth, and widens the pharynx.<sup>6</sup> The genioglossus depresses the tongue, especially the central part, creating a longitudinal furrow, while the posterior part pulls the tongue anteriorly for protrusion, the anterior-most part retracts the apex of the protruded tongue, and unilateral contraction deviates the tongue to the contralateral side.<sup>7</sup>

In contrast, the laryngeal release technique of Dedo and Fishman<sup>5</sup> is a surgical method that divides the thyrohyoid muscles and membrane above the larynx. It permits the trachea to move 2.5 cm downward.<sup>5</sup> The four infrahyoid muscles (the omohyoid, sternothyroid, sternohyoid, and thyrohyoid) anchor the hyoid, sternum, clavicle, and scapula and depress the hyoid and larynx during swallowing and speaking. They also work with the suprahyoid muscles to steady the hyoid, providing a firm base for the tongue.<sup>6</sup> The sternohyoid depresses the hyoid after elevation during swallowing.<sup>6</sup> The omohyoid depresses, retracts, and steadies the hyoid, while the thyrohyoid muscle depresses the hyoid and elevates the larynx.<sup>6</sup>

The suprahyoid release is thought to result in less interference with deglutition, except for discomfort in swallowing during the early postoperative days.<sup>4</sup> At first glance, more muscles must be severed in the suprahyoid release than in the laryngeal release of the infrahyoid muscles, so the impact on deglutition seems greater in the former. In the immediate postoperative period, our patient

complained of mildly impaired tongue movement, but did not experience as much difficulty as we expected and she could eat an ordinary diet without problems. We believe that this occurred because it was difficult for the widened and shortened pharynx to receive a bolus of food as the suprahyoid muscles contracted. Basically, if the epiglottis blocks the laryngeal inlet tightly, no problem exists because the sequential contraction of all three constrictor muscles (superior, middle, and inferior constrictor muscles) forces the food bolus inferiorly into the esophagus.<sup>8</sup> Therefore, we believe that the suprahyoid technique does not influence deglutition. The tongue is moved by four intrinsic (superior longitudinal, inferior longitudinal, transverse, and vertical) and four extrinsic (genioglossus, hyoglossus, styloglossus, and palatoglossus) muscles. Therefore, even if one muscle (genioglossus) fails, the movement of the tongue might not fail because the other seven muscles could compensate for it.

In addition, the hyoid bone is severed. What is the role of the hyoid bone in the first place? The hyoid is U-shaped, and consists of a body and the greater and lesser horns. Anatomically, the hyoid is located centrally in a tug-of-war between the mandible superiorly and the manubrium inferiorly through the anterior neck muscles. Functionally, the hyoid serves as an attachment for the anterior neck muscles and as a prop to keep the airway open.<sup>6</sup> Therefore, we believe that severing the hyoid does not markedly influence deglutition.

#### 5. Conclusion

We performed a tracheoplasty requiring a suprahyoid release for adenoid cystic carcinoma as an oncologic emergency. We should master the supralaryngeal release, particularly wide resection of the trachea, because this technique provides sufficient mobilization, with no dysphagia or complications.

#### Conflict of interest

The authors indicated no potential conflicts of interest.

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